RECORD OF DECISION

CENTER HILL DAM AND LAKE
DEKALB COUNTY TENNESSEE

CHANGES TO CENTER HILL LAKE ELEVATIONS

SYNOPSIS

The Notice of Availability of the Final Environmental Impact Statement (FEIS) for Changes to Center Hill Lake Elevations at Center Hill Lake and Dam, DeKalb County, Tennessee, was filed with the Environmental Protection Agency and provided to the public by Federal Register on November 9, 2007. The Corps of Engineers (Corps) was lead agency, and the US Fish and Wildlife Service (USFWS) and the Tennessee Valley Authority (TVA) were cooperating agencies in the preparation of the FEIS. The review period for the FEIS expired on December 10, 2007. The FEIS was prepared pursuant to regulations of the National Environmental Policy Act (NEPA), Council of Environmental Quality (40 CFR 1505.2) and the implementing policy and procedures of the U.S. Army Corps of Engineers (33 CFR 230.14). This Record of Decision documents the decision of the Director of Civil Works to proceed with implementing Alternative 5 which will lower pool elevations for Center Hill Lake to minimize the potential of dam failure.

DECISION

The interim pool alternative selected to minimize the potential for dam failure is Alternative 5, the Dam Safety and Engineering Preferred Alternative. This alternative would maintain Center Hill Lake between elevations (EL, National Geodetic Vertical Datum of 1929, commonly referred to as feet above mean sea level) EL 630 to EL 618. This elevation range is significantly lower than the normal operating range within the Power Marketing Band (PMB) between EL 648 to EL 623.5 respectively.

There are several compelling reasons for selecting Alternative 5, the Dam Safety and Engineering Preferred Alternative. Computation methods and empirical data were used to gage the severity of seepage problems, structural reliability of the dam, and risk of dam failure. Though unlikely, a dam failure would assuredly result in catastrophic infrastructure and property destruction; regional and national economic disruption, environmental damage, and a high probability of the loss of life.

It would take decades to recover from such an event. While it is not possible to make an estimate as to when such a failure would occur, it is essential, that immediate action is taken to reduce risks to the public and the environment. Considering the disastrous magnitude and far-reaching effects a dam failure would produce, ultimate safety for downstream population centers and protection of the environment must out-weigh significant, but temporary, and highly localized impacts to the project benefits of hydropower, water supply, fish & wildlife, water quality, recreation, and navigation. An independent External Peer Review Panel (Panel) concurred with the Corps' findings that Center Hill Dam be assigned a Dam Safety Action Classification of I, urgently in need of remediation. "The Panel recommends immediate action to maintain the reservoir level as low as possible while still operating and providing most of the reservoirs benefits. The Panel recommends maintaining the pool level at or below elevation 620 to 630 all year. This pool restriction should remain in place until further information is available from field investigations and the grouting program to enable a better evaluation of the appropriate reservoir restrictions - be it higher or lower." The Panel's recommendation carries great weight. In considering an alternative that would balance acceptable protection to downstream populations and the environment, and reasonably sustain project benefits and the local and regional economy, it is my decision that Center Hill Lake should be lowered as soon as practicable and maintained between EL 630 to EL 618 to reduce the probability and consequences of a potential dam failure to the maximum extent possible. During the 7 to 10 year repair period this alternative interim pool operation will be periodically re-evaluated.

The Corps has developed an adaptive management decision making process to decide at what pool level Center Hill Lake would be held. As repair work is completed, and the risk of dam failure is substantially diminished over time, adaptive management will be used to re-evaluate risk. The adaptive management process will be used at different points in time for the duration of the repair work. Examples of times at which this process could take place are: 1.) Complete grouting in the foundations of the Left Rim and Main Dam embankment (estimated March 20010); 2.) Complete grouting in the foundations of the Right Rim, Main Dam Concrete Section, and Saddle Dam (estimated September 2011); and 3.) Complete installation of the Concrete Cutoff Walls into the foundations of Main Dam and Saddle Dam Embankments (estimated September 2013). These examples are illustrative only and are not a guarantee the Corps will raise or lower the pool at these times. Proof of substantial risk reduction will be based on the

completion of these structural measures and validated by performance indicators and continued overall stability and improvement in Center Hill Dam. The performance indicators are: continued stable, downward trend of piezometer readings, continued stable trend of reduced areas of wet spots, no anomalies in monitored settlement, and no anomalies based on visual inspections. This information will be used by the Corps to make recommendations on incremental pool level changes including the possibility of considering raising lake elevation. However, if during the repair period, or event of imminent dam failure occurs, emergency drawdown will be implemented to allow the lake to be drastically lowered and even drained if possible, until the emergency has passed and the lake can be safely raised.

PROJECT AUTHORITY AND NEED FOR PROPOSED ACTION

The United States Congress authorized dam repairs and funding was provided by District O&M funds for the Center Hill project to prepare the Major Rehabilitation Evaluation Report (MRER) that addressed Seepage concerns at Center Hill Dam. The Center Hill project was originally authorized by the Flood Control Act approved June 28, 1938 (Public No. 761, 75th Congress, 3rd session). The primary project purposes were flood damage reduction and hydropower production. Dam rehabilitation is being completed under the same authorization. After report approval by the Corps of Engineers Great Lakes and Ohio Rivers Division (CELRD) in August 2006, the Nashville District (District) acquired Construction, General (CG) funds from the Dam Safety Assurance and Seepage/Stability Correction Program (Wedge Funds) to proceed with engineering and design activities. In addition to this report, an independent and external Corps Dam Safety Action Classification Peer Review Panel (Panel) was formed to evaluate the Corps findings. The Panel concurred with the MRER findings that under EC 1110-2-6064 "INTERIM RISK REDUCTION MEASURES FOR DAM SAFETY", the Corps Class I designation (Urgent and Compelling) for Center Hill Dam was appropriate. The District has budgeted for construction new start funds under the Construction, General appropriation for Fiscal Year 2008. The proposed project is designed as a reliability-based improvement and will require full federal funding.

The national economic development (NED) plan, and recommended plan, is to install permanent cutoff walls and supplemental grouting into the main dam embankment and saddle dam foundations. Grouting is also proposed to arrest seepage along

both abutments, rims, and the concrete dam. During the life of the project, two maintenance grouting programs are planned at approximate 18-year intervals. The plan yields net NED annual benefits of over $36 Million and has a Benefit-to-Cost ratio of 3.4. The total cost of the plan is estimated at $240 Million. The remediation project is estimated to be completed by the end of 2013. Completion of the dam repairs will increase the reliability of the structure and extend the project life well into this century, resulting in continuing project benefits.

Since 2005, the District has lowered Center Hill Lake elevations to help take some stress off the project features. This modified operation reflects a compromise between the need to lessen stress on the dam and the needs of customers who benefit from the dam. During the evaluation process, it became clear that even lower lake elevations incrementally reduce the risk of pool loss or dam failure. Consequently, an Environmental Impact Statement (EIS) was written to evaluate the impact alternative interim pool elevations, including emergency drawdown of the lake, could have on project benefits and the human and natural environment.

ALTERNATIVE PLANS CONSIDERED

The safety and reliability of Center Hill Dam is directly connected to Center Hill Lake elevations as evidenced by lower rates of seepage and lower piezometer measurements with lower pool elevations. As a result, the scoping phase of the FEIS process resulted in the identification and evaluation of nine Alternative interim pool elevations. The Corps considered all applicable laws, executive orders, regulations, local government plans, and input provided from the cooperating agencies in evaluating the alternatives. All nine alternatives covered lake elevations from normal operations to draining the lake and were evaluated in great detail in the FEIS.

Alternative 1 (EL 648 to EL 623.5) was the normal operating elevations that would have optimized all of the authorized purposes but had the highest potential of dam failure and the greatest risk to the safety of downstream populations. Alternative 2 (EL 645 to EL 623.5) did little to reduce risk. Alternative 3 (EL 640 to 623.5) was the Existing Condition that supported all project benefits with minor impacts. This alternative was preferred by Trout Unlimited and the Environmental Protection Agency. While this alternative reduced hydrostatic pressure on the dam and lessened the risk of dam

failure, it provided little safe floodwater storage capacity. Under normal operating conditions water storage into the flood pool (EL 648 to EL 685) would be reasonable, but for safety concerns during dam repairs, floodwater storage would be small. A rise of floodwater by several feet would elevate the risk of dam failure to an unacceptable level.

Alternative 4 (EL 635 to EL 623.5) was Environmentally Preferred because it would have minor economic effect on water supply, recreation, and incidental navigation; moderate effect on hydropower; and minor to moderate environmental effects on water quality, fish and wildlife. Alternative 4 was the option preferred by water suppliers, marina operators, fishermen associations, state, other Federal agencies and the public at large. Hydropower capabilities would be lost in a dry year. During a wet year, storing floodwaters could jeopardize the safety of the dam when a pool rise of 15 to 20 feet during storm events is not uncommon.

Alternative 5 (EL 630 to EL 618) was the Dam Safety and Engineering Preferred option. It had moderate to severe impacts to all project uses and economic benefits depending on the year's rainfall. During a drought, there would be just enough water to sustain all project uses except hydropower. Under the Corps' Drought Contingency Plan coupled with the Cumberland River Basin Reservoir System Water Management Operating Plan During Interim Pool Restrictions at Wolf Creek and Center Hill Dams, use of limited stored water would be prioritized to first protect water supplies, followed by water quality, navigation, hydropower, and recreation. During a wet year, flood water could be safely stored and released in a controlled manner so as not to jeopardize the integrity of the dam or safety of downstream populations and the environment with increased flooding. Alternative 5 significantly reduces hydrostatic pressure on the dam and reduces the risk of dam failure to a tolerable level that reasonably provided protection to downstream populations without sacrificing all the project benefits and creating local and regional economic hardship. In light of the concerns, every effort has been made to avoid, minimize, and mitigate impacts to these important resources as described below.

Alternatives 6, 7, and 8 (EL 625 to 623.5, EL 625 to EL 618, and Flat-line EL 622 respectively) would ensure a safe dam, but would eliminate nearly all the project benefits and assuredly result in economic hardship that would take years for the local and regional economy to recover. Alternative 9 is the emergency

drawdown alternative. In the event of unforeseen circumstances, this alternative would be implemented to save the dam and minimize damage to downstream populations and the environment.

FACTORS CONSIDERED TO MINIMIZE ADVERSE IMPACTS AND ADDRESS PUBLIC CONCERNS

The goal of this FEIS was to identify an alternative that balanced safety against the loss of project benefits. Based on the public and agency scoping and review for this project, many project benefits and resources of concern were identified. Lowering and maintaining a reduced pool could have negative effects on hydropower, water supply, recreation, water quality, fish and wildlife, threatened and endangered species, and navigation. Under the worst case scenario, hydropower production could be foregone, thermal power plants could be de-rated due to lack of cooling water, water quality could decrease, aquatic life including federally listed species could be stressed, a trout fishery below the dam could be temporarily lost, endangered bats may attempt to use exposed caves, water supply treatment costs could increase, recreation could decline as public and marina boat ramps were closed, navigation could be reduced and the local and regional economy could be impacted. The actual severity of the impacts would depend on a number of factors including the chosen alternative, weather, including rainfall and temperatures, and conditions at other lakes within the Cumberland River Basin. These negative short-term affects are unavoidable, but considered prudent when weighed against the risk of dam failure.

In consideration of these concerns the following environmental commitments have been made to avoid, minimize or mitigate potential impacts to the natural and human environments. These commitments remain in effect until Center Hill Dam can be restored to the status quo conditions of normal lake level operations

- **Water Quality Condition Improvements for Aquatic Life**. Some water quality impacts to aquatic life could be greatly minimized by mitigation measures that would be employed that are considered reasonable and prudent.
    - o Installation of an Orifice Gate over a sluice gate would replace seepage flow of about 130 cubic feet per second (cfs) by providing an optimum minimum flow of approximately 200 cfs for the trout fishery below the dam. The orifice gate would provide cold, well

oxygenated water to meet the trout stream classification in the tailwater below the dam. This structural change on Center Hill Dam would benefit both the tailwater and the upper end of Old Hickory Lake.

- o Rehabilitate the power house service generator to provide a reliable flow of an additional 70 cfs if needed and as emergency continuous flow for a short period of time if the orifice gate requires repairs and is closed.
- o Blending hydropower turbine and sluice gate discharges could improve the tailwater condition. When the lake stratifies, most of the dissolved oxygen in the deeper portions of the lake is consumed by ongoing chemical and biological processes. Consequently, water discharged through the turbines is very low in dissolved oxygen and the tailwater ecology suffers. Water discharged through the sluice gates provide ample dissolved oxygen. Thus, when generation is required during the warmer months a sluice gate can be opened and as the waters from the turbines and the sluices blend, adequate cold water and dissolved oxygen is achieved. This would benefit both the tailwater and the upper end of Old Hickory Lake.

- **Biological Surveys**. The following survey plans have been developed by the Corps to address the concerns of the USFWS. These actions undertaken by the Corps are considered reasonable and prudent measures to track the well-being of aquatic and wildlife resources when the lake is lowered under Alternative 5 and for the duration of the dam repair period.
  - o The Corps has agreed to the USFWS request for water quality and biological integrity (macroinvertebrates and fish community) surveying in the tailwater below Center Hill Dam at Caney Fork River Miles (CFRM) 7.3, 11.1, and 21.3. Surveys would be planned quarterly (seasonal). The information would provide valuable data on biological and habitat responses to altered tailwater conditions affecting stream volume, depth, velocity, temperature, dissolved oxygen, chemical content, and habitat area as a result of operational changes, reduced seepage, service generator modification, installation of an orifice gate, and blended sluice and turbine flows.
  - o The Corps has agreed to the USFWS request to conduct bat surveys around Center Hill Lake because of a concern that endangered bats may attempt to use exposed caves that under normal pool operations are submerged. To address this concern, the Corps would examine historical maps, talk to subject matter experts, and survey potential sites around the lake perimeter to locate temporarily

exposed cave resulting from extended low lake elevations. Should any such caves be occupied by endangered bats, the Corps will confer with the U.S. Fish and Wildlife Service for appropriate action.

- **Water Supply Protection.** By way of letter dated September 18, 2007, the Tennessee Department of Environment and Conservation, Division of Water Supply (DWS), expressed concerns regarding water supply protection of intakes in Center Hill Lake and below Center Hill Dam. On October 12, 2007 the Corps met with DWS and water suppliers at the Center Hill Resource Manager's Office to discuss their concerns. The following measures would be taken for the duration of the dam repair period to protect water quantity and quality
  - o An orifice gate would be installed to provide a minimum flow of 200 cfs would be provided to protect water supply intakes below Center Hill Dam.
  - o Water suppliers in the Caney Fork River tailwater would be notified when dam releases are altered due to implementation of water quality condition improvements noted above so they can adjust water treatment processes as necessary.
  - o Center Hill Lake elevation would not be lowered below EL 618 to ensure water supply intakes are adequately submerged. In the event this is not possible due to the effects of drought, excessive water withdrawal, maintenance of minimum flow below the dam, or emergency drawdown, the Corps would expedite any Corps permits that may be required to lower water supply intakes in Center Hill Lake.

- **Historic Properties.** By way of letter dated November 16, 2007, the Tennessee State Historic Preservation Officer (SHPO) noted that the FEIS had been reviewed and concurred "...that the Alternatives 2 - 7, as currently proposed will not adversely affect any property that is eligible for listing in the National Register of Historic Places. Therefore, this office has no objection to the implementation of these alternatives." Unless plans are changed this completes the Corps' compliance requirements under Section 106 of the National Historic Preservation Act.

- **Recreation**. On September 28, 2007, the Corps met with marina operators at the Center Hill Resource Manager's Office to discuss their concerns regarding lake operation. A lower lake could result in unusable boat ramps, submerged hazards, and reduced fishing opportunities.

- Where and when possible, boat ramps would be extended and marinas would be allowed to reconfigure.
- The Corps would work with private dock owners in improving accessibility to the lake by encouraging use of available public boat ramps.
- The Corps would increase safety awareness.
- The Corps would work with the Tennessee Wildlife Resources Agency (TWRA) to encourage installation and/or relocation of fish attractors or other fish habitat devices to preserve good fishing conditions in Center Hill Lake.
- The Corps would coordinate with TWRA to preserve the trout fishery in the tailwater below Center Hill Dam.

- **Hydropower**. Center Hill was designed and is operated for hydropower production which is the primary and preferred method for regulating the lake level. A lower lake level could have a moderate impact on hydropower by reducing the amount of stored water used to generate hydropower which reduces the amount of electricity supplied to the power grid. The following actions may help compensate for lost power.
  - Every effort would be made to generate hydropower when releases in excess of minimum flow are needed.
  - Lost hydropower at Center Hill may be compensated by storing additional water in other tributary projects for later hydropower releases in an attempt to maintain no net loss of hydropower.
  - Install an orifice gate over a sluice gate. An orifice gate would release 200 cfs as opposed to only a sluice gate that releases 1,500 cfs to meet water temperature and dissolved oxygen requirements for tailwater aquatic life. This action could help preserve water storage.
  - Rehabilitate the power house service generator to provide reliable back-up power to the power house to run the hydropower turbines in the event of an electrical power outage.

- **Compensation to the Cumberland River System**. During lower lake operations, Center Hill Lake may not be able to provide the Cumberland River System with adequate water quantity or quality. To compensate for this condition, the following actions may be necessary.
  - Supplemental flows from other tributary lakes (Dale Hollow and/or J. Percy Priest) may be necessary to provide minimum flow and/or improved water quality

through the system. When possible, excess water may be stored in these tributary lakes for later release.

- o Under normal operations the flow in the Cumberland River system is regulated via hydropower generation. With reduced water quantity in the system which reduces water quality, the Corps may need to resort to spilling water through the tainter gates instead of releasing water through hydropower generation at the Cordell Hull, Old Hickory, and Cheatham dams to maintain adequate flow and/or water quality condition. Protecting water quality condition may result in power lost by foregoing hydropower generation.
- o The Corps will work with TVA to identify measures that would protect thermal power generation. Thermal power relies on cold water supplied by the Cumberland River System for cooling purposes, and adequate flow to ensure safe navigation for coal supplies.

- **Navigation**. Navigation is not a project purpose at Center Hill. However, under normal operations, tailwater releases from Center Hill augments flow in the Cumberland River to aid navigation. Under Center Hill Lake elevation restrictions during the dam repair period, tailwater flow may be reduced and therefore provide little water to the system. In order to minimize impact to navigation, water releases from Center Hill Lake and throughout the Cumberland River System to meet water quantity and quality needs may be timed to provide 4 hour windows to accommodate travel through the Cumberland River lock and dams.

- **Flood Control**. A Cumberland River system operating plan would be adopted that incorporates the modifications at Center Hill Dam. The plan would not compromise flood damage reduction capability at Center Hill Dam or within the Cumberland River system. Consideration will be given to downstream impacts on the Caney Fork and Cumberland Rivers.

Compliance with applicable environmental review and consultation requirements has been integrated in this NEPA process. The FEIS documents consideration of and compliance with NEPA, the Fish and Wildlife Coordination Act; Endangered Species Act; Clean Water Act; Clean Air Act; Comprehensive Environmental Response, Compensation, and Liability Act; Resource Conservation and Recovery Act; Toxic Substances Control Act; Archaeological Resources Protection Act; Executive Order 11988 (Floodplain Management); Executive Order 11990 (Protection of Wetlands); Executive Order 12372 (Intergovernmental Review of Federal

Programs); Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority and Low Income Populations); Executive Order 13045 (Protection of Children From Environmental Health Risks and Safety Risks); National Historic Preservation Act; and other applicable environmental protection statutes, regulations, and orders. All practicable means to avoid or minimize, and mitigate environmental harm from the selected alternative have been adopted.

CONCLUSIONS

I have reviewed and evaluated all documents pertaining to the interim pool elevation alternatives at Center Hill Dam and Lake, including the views of the State of Tennessee, other federal agencies, affected stakeholders, and the public. I find that the FEIS has been developed consistent with national environmental statutes, applicable laws, regulations, administrative directives, executive orders, and other Federal planning requirements. Environmental commitments contain actions that would avoid, minimize or mitigate adverse environmental effects to the extent practicable and adequately compensates for unavoidable negative impacts to significant resources.

I have concluded that the benefits of Alternative 5, the Dam Safety and Engineering Preferred alternative (EL 630 to EL 618) outweigh any potential adverse effects. Implementation of this alternative is in the public interest. Alternative 5 provides the best practicable means to balance the need to reduce the risk of dam failure and ensure safety to the downstream populations and the environment. After careful review of all concerns, my decision is to implement Alternative 5, the Dam Safety and Engineering Preferred alternative as described in the FEIS. This Record of Decision completes the National Environmental Policy Act (NEPA) process.

13 Feb 2008
Date:

BRUCE A. BERWICK
Brigadier General, U.S. Army
Commanding